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Aspen Availability and Supply

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Lake States Forest Experiment Station

LAKE STATES ASPEN REPORT NO. 2

ASPEN AVAILABILITY AND SUPPLY

BY
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FOREWORD

During and since World War II, there has been increasing interest in aspen (*Populus tremuloides*) in the Lake States, its availability and supply, properties and uses, and management. Aspen is a tree of primary importance in 20 million acres or 40 percent of the total forest area of the three Lake States - Michigan, Minnesota, and Wisconsin.

At an informal meeting at Madison, Wisconsin, in January, 1947, forestry representatives of several federal, state, and industrial groups in the Lake States agreed that it would be desirable to bring up to date what is known on aspen and make it available to anyone interested. The job of preparing this information in the form of reports was assigned to each of the groups listed below. The reports will be duplicated as rapidly as completed, and the entire project should be finished by the end of 1947. Each report will concern one aspect of the subject. Copies will be available from the Lake States Forest Experiment Station or from each contributor.

Report Number	Subject
1	Aspen Properties and Uses
2	Aspen Availability and Supply
3	Logging Methods and Peeling of Aspen
4	Milling of Aspen into Lumber
5	Seasoning of Aspen
6	Aspen Lumber Grades and Characteristics
7	Mechanical Properties of Aspen
8	Machining and Related Properties of Aspen
9	Aspen Lumber for Building Purposes
10	Aspen for Containers
11	Aspen for Core Stock
12	Small Dimension and Other Industrial Uses of Aspen
13	Aspen for Veneer
14	Aspen for Pulp and Paper
15	Aspen for Cabin Logs
16	Aspen for Excelsior
17	Aspen Defiberization and Refining of Product
18	Chemical Utilization of Aspen
19	Preservative Treatment of Aspen
20	Marketing of Aspen
21	Possibilities of Managing Aspen

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REPORT NO. 2

ASPEN AVAILABILITY AND SUPPLY

By
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A knowledge of the total and available supply of aspen is basic to a study of the aspen situation. Hence, this paper aims to show the relative position of aspen2/ as a commercial forest type in the Lake States region, both currently and potentially. The data on areas, volumes, and growth are taken from the Forest Survey made in 1933-37, brought up to January 1, 1945, by office calculations including drain studies. Areas by site quality, allowable cut calculations, and volumes of timber available (1945 to 1960) are the best estimates that can be made at this time.

DISTRIBUTION OF ASPEN TYPE, SIZE CLASSES, AND SITES

Areas by Type and Size Class

The aspen type3/ occupies 19,858,000 acres or 39 percent of the commercial4/ forest area in the Lake States. The next largest forest type, northern hardwoods, occupies only 19 percent, or less than half the area of aspen cover. The following chart shows that the aspen type occupies a considerable area in each of the three states and reaches a high of 45 percent of the commercial forest area in Minnesota.

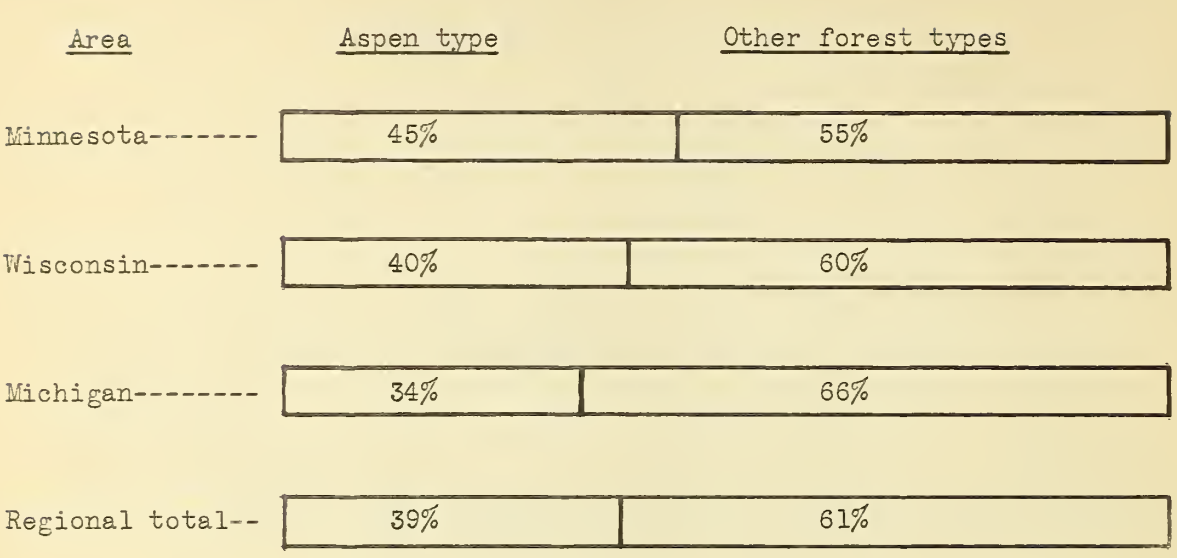
1/ Maintained by the U. S. Department of Agriculture, Forest Service, in cooperation with the University of Minnesota, University Farm, St. Paul 1, Minnesota.

2/ Aspen as used in this paper includes large tooth aspen (Populus grandidentata), balm of Gilead (Populus balsamifera), and cottonwood (Populus deltoides) as well as the major species, trembling aspen or popple (Populus tremuloides) which is estimated to make up about 80 to 90 percent of the volume of the group.

3/ This is the Forest Survey's aspen-birch cover type in which "aspen and paper birch, either singly or together, make up more than 50 percent of the stand." Aspen volume figures do not include paper birch.

4/ Land capable of bearing some commercial species though not necessarily aspen. The area given includes an estimated 6,200,000 acres of poor and off-site aspen. It also includes 4,825,000 acres of poorly stocked and denuded aspen lands.

Chart 1.-Dominance of the aspen type, 1945



The aspen cover type is well represented in each size class as may be seen from the following: This type covers 18 percent of the saw timber area, 38 percent of the pole timber area, 50 percent of the seedling and sapling area, and 35 percent of the poorly stocked or denuded area in the region.

Table 1 shows the distribution of the aspen type by size classes for each survey district. Merchantable size classes occupy almost 5 million acres in the region and are quite evenly divided among the three states. Some 10 million acres of land are occupied by fairly well-stocked stands of aspen seedlings and saplings up to 5 inches d.b.h. Almost 5 million acres are classified as aspen land but are so poorly stocked as to be practically deforested. Similar relationships hold for each state and survey district.

Chart 2 gives the area of aspen size classes within each state. Approximately 24 percent of the aspen type in the region is now in merchantable size classes, 5 inches or larger at d.b.h. Some 52 percent of the aspen type is classified as satisfactorily restocked to seedlings and saplings. A large part of this will pass into pole size before 1965 making a very large volume of aspen available for harvesting beginning in the 60's.

Table 1.-Distribution of commercial aspen type by size classes, states, and survey districts, 1945

State and survey district[1]		Saw timber[2]	Pole timber[2]	Seedlings & saplings[2]	Poorly stocked & denuded[2]	Total
		Thousands of acres				
Minnesota	1	180	440	1,580	500	2,700
	2	240	440	1,540	560	2,780
	3	100	140	670	290	1,200
	4	20	30	210	290	550
	5	10	20	120	120	270
Total		550	1,070	4,120	1,760	7,500
Wisconsin	1	82	360	1,100	460	2,002
	2	125	610	1,405	665	2,805
	3	53	105	640	656	1,454
	4	30	20	80	67	197
Total		290	1,095	3,225	1,848	6,458
Michigan	1	117	225	629	160	1,131
	2	90	260	530	170	1,050
	3	110	914	1,529	722	3,275
	4	10	55	214	165	444
Total		327	1,454	2,902	1,217	5,900
Region		1,167	3,619	10,247	4,825	19,858

1/ Boundaries of survey districts are shown on map on page 12.

2/ Stand size classes are defined as follows:

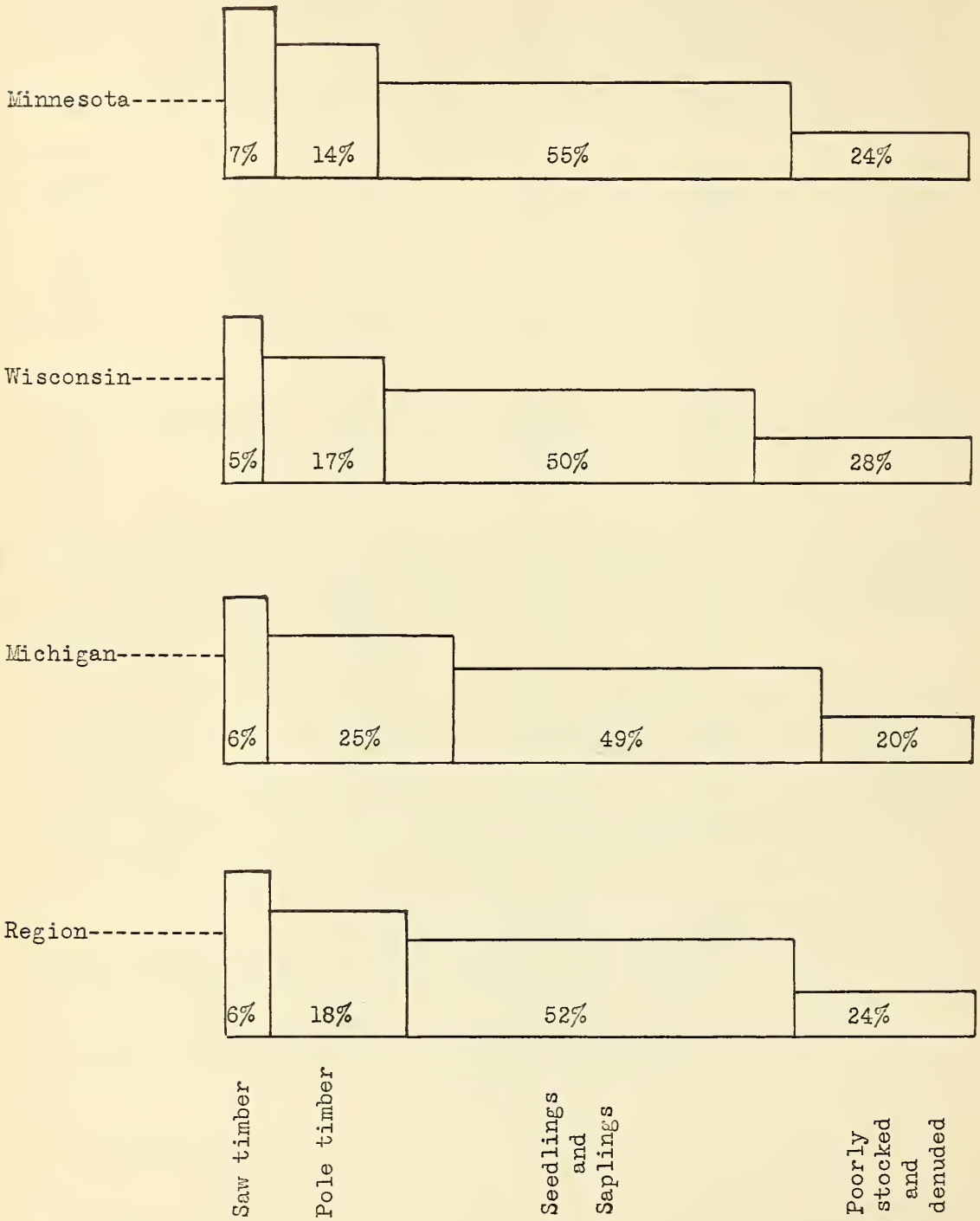
Saw timber - Lands with at least 2,000 board feet (Int. ¼-inch rule) of merchantable saw timber per acre in trees over 9 inches d.b.h.

Pole timber- Lands with from 3 cords to 2,000 board feet of merchantable wood per acre, mostly in trees from 5.0 to 8.9 inches d.b.h.

Seedlings & saplings - Lands at least 40 percent stocked to commercial tree species up to 4.9 inches d.b.h.

Poorly stocked and denuded-Commercial forest lands bearing less than 2,000 board feet or 3 cords and less than 40 percent stocked to seedlings and saplings.

Chart 2.-Distribution of aspen area by tree size classes and states, 1945



Site Class Areas

Commercial forest land occupied by the aspen type has been classified into three broad site classes[5] by states, as shown in table 2. Of the total of nearly 20 million acres of aspen, over half is estimated to be in the medium class, with one-third in the poor and one-sixth in the good site classification.

Table 2. Aspen site classification by site quality and state, 1945

State	Good site (Site index - 68+)	Medium site (Site index - 60-70)	Poor site (Site index - 59-)	Total
	Thousands of acres			
Minnesota	1,500	4,125	1,875	7,500
Wisconsin	646	3,552	2,260	6,458
Michigan	885	2,950	2,065	5,900
Region	3,031	10,627	6,200	19,858
	15%	54%	31%	100%

THE CURRENT SUPPLY OF ASPEN

Saw Timber Volume

Table 3 shows the distribution of aspen[6] saw timber by states and survey districts and by stand size classes. In 1945, there were approximately 6 1/3 billion board feet (International ¼-inch rule) of aspen saw timber in the Lake States. This included the volume of trees 9.0 inches and larger d.b.h. contained in logs at least 10 feet long and at least 6 inches d.i.b. Aspen constituted 13 percent of the saw timber volume of all tree species in the region. Of this volume, almost 4½ billion board feet (70 percent) occurred in saw timber size stands and the balance was scattered through pole and unmerchantable stands. Approximately one-half of the region's aspen saw timber volume was located in Minnesota. In survey district 2 of Minnesota, aspen composed 35 percent of the total saw timber volume with 88 percent in merchantable sized stands. The last column in table 3 shows the estimated volume of aspen available in 1945. This is

5/ Site quality classes of land stocked with aspen:
Good - Land generally capable of producing small saw-log material (especially when site index is 70+). With intensive management and protection, perhaps all land in this site class might produce aspen saw timber. Much of it may convert naturally to other types.
Medium - Land capable of producing high-grade pulpwood but usually incapable of producing good quality saw logs.
Poor - Land incapable of producing much high-grade pulpwood. Considered off-site for aspen if index is below 50.

6/ Aspen volume, growth, drain, and allowable cut figures do not include paper birch but do include all Populus species.

the volume of present merchantable stands discounted for inaccessibility, for rot, and for the loss resulting from overmaturity, which would be incurred before these stands could all be harvested. While only an estimate, it presents an idea of the amount of aspen saw timber which might be harvested under normal practices in comparison to the total 1945 saw timber growing stock.

Table 3.--Saw timber volume of aspen on commercial forest land by stand size class, state and survey district, 1945.

State and survey district 1/		Saw timber	Pole timber	Seedlings and saplings	Poorly stocked and denuded	Total 1945	Estimated available 1945
		Million feet, board measure (Int. ¼-inch rule) 2/					
Minnesota	1	787	394	94	9	1,284	854
	2	789	266	133	10	1,198	994
	3	300	70	32	8	410	304
	4	142	24	14	3	183	153
	5	103	56	13	3	175	127
Total		2,121	810	286	33	3,250	2,432
Wisconsin	1	199	51	7	3	260	240
	2	301	90	8	8	407	372
	3	277	44	26	5	352	290
	4	182	23	11	5	221	163
Total		959	208	52	21	1,240	1,065
Michigan	1	601	145	14	2	762	693
	2	225	41	5	4	275	253
	3	343	205	15	5	568	470
	4	236	40	5	4	285	225
Total		1,405	431	39	15	1,890	1,641
Region total		4,485	1,449	377	69	6,380	5,138

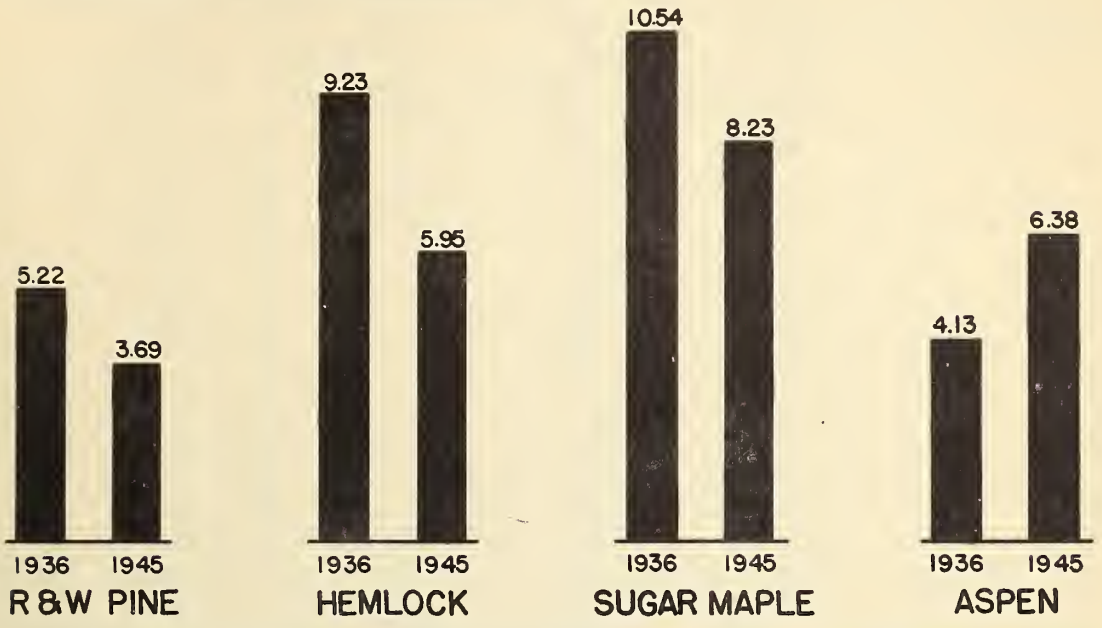
1/ See survey districts on map on page 12.
2/ Volume of trees over 9 inches d.b.h. contained in logs at least 10 feet long and at least 6 inches minimum diameter - by International ¼-inch rule.

CHART 3

COMPARISON OF TIMBER VOLUMES

LAKE STATES 1936-1945

SAWTIMBER-BILLION BOARD FEET



TOTAL VOLUME - BILLION CUBIC FEET

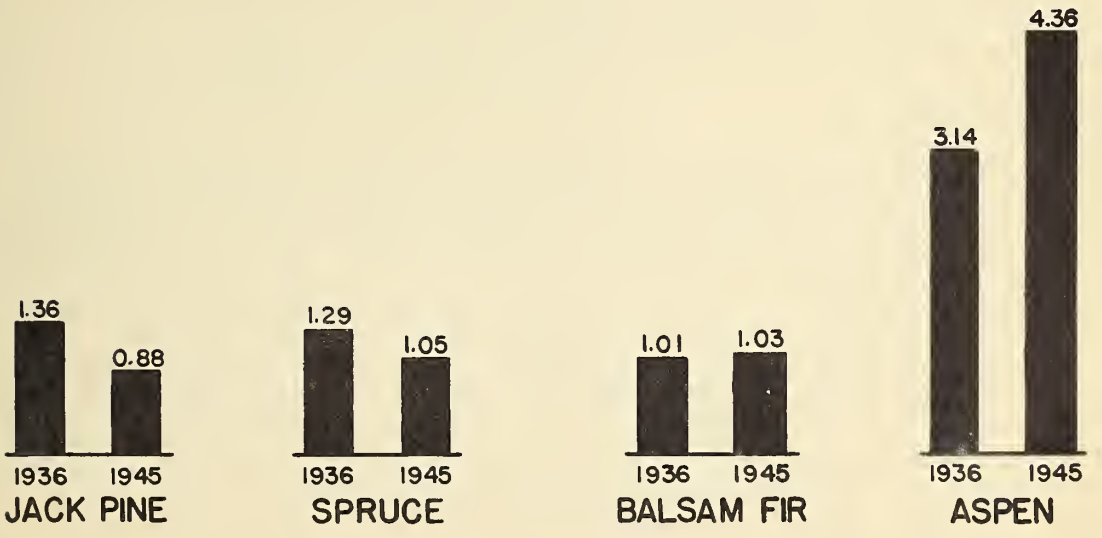


Table 4.-Cubic volume of aspen on commercial forest land by size class, state, and survey district, 1945

State and survey district 1/		Saw timber	Pole timber	Other areas	Total
		Million cubic feet 2/			
Minnesota	1	204	328	141	673
	2	360	317	84	761
	3	91	52	13	156
	4	45	28	22	95
	5	39	94	32	165
Total		739	819	292	1,850
Wisconsin	1	116	128	36	280
	2	158	248	49	455
	3	67	47	31	145
	4	55	17	8	80
Total		396	440	124	960
Michigan	1	190	135	26	351
	2	159	117	25	301
	3	259	465	76	800
	4	55	35	8	98
Total		663	752	135	1,550
Region total		1,798	2,011	551	4,360

1/ See survey districts on map on page 12.
2/ Volume of trees over 5 inches d.b.h. to a 4-inch minimum top.

Pulpwood Volumes

The volume of different grades of pulpwood material available in 1945 is shown in table 5. Standard pulpwood means the material that can be cut from trees 5 to 9 inches d.b.h., yielding two or more 8-foot sticks, to a 4-inch top diameter inside bark, with little defect or crook. There were 17 1/3 million cords of this material in 1945, or 41 percent of the total volume of all common pulpwood species. If all aspen saw log material were considered as pulpwood, the total pulpwood volume would be almost doubled. Furthermore, if standards were lowered to permit the pulping of all aspen sticks over 4 inches d.i.b. with less than 50 percent defect, the utilizable volume would be increased by over 25 million cords. Table 5 shows approximately one-half of the aspen pulpwood in this region to be in districts 1 and 2 of Minnesota and district 3 of Michigan.

The total volume of aspen pulpwood in this region is almost as great as the volume of all other common pulping species combined and approximately four times as large as the supply of either spruce or balsam fir. 7/

Table 5.- Aspen pulpwood by class of material, state, and survey district, 1945

State and survey district 1/		In saw logs 2/	Standard pulpwood 3/	Substandard pulpwood 4/	Total 5/	Percent of State total	Percent of Region total
		Thousands of cords (with bark)					
Minnesota	1	3,080	2,350	3,600	9,030	36	15
	2	2,880	3,150	3,990	10,020	41	17
	3	990	320	870	2,180	9	4
	4	430	330	500	1,260	5	2
	5	420	850	840	2,110	9	4
Total		7,800	7,000	9,800	24,600	100	42
Wisconsin	1	680	1,220	1,680	3,580	28	6
	2	1,070	2,010	2,720	5,800	45	10
	3	660	450	980	2,090	16	4
	4	590	120	620	1,330	11	2
Total		3,000	3,800	6,000	12,800	100	22
Michigan	1	1,820	900	2,400	5,120	25	9
	2	650	1,420	1,830	3,900	19	7
	3	1,350	4,050	4,750	10,160	49	17
	4	680	130	710	1,520	7	3
Total		4,500	6,500	9,700	20,700	100	36
Region total		15,300	17,300	25,500	58,100	--	100

1/ See survey districts on map on page 12.
2/ Approximate cordwood equivalent of merchantable saw logs 6 inches and larger in diameter.
3/ Volume of standard pulpwood sticks below saw log size. Does not include volume in trees containing less than two 8-foot pulpwood sticks.
4/ Defective saw logs, substandard pulpwood sticks, and volume in one-stick trees.
5/ Total volume to a 4-inch top.

7/ Volume of standard pulpwood in 1945 (in thousands of cords): spruce - 7,100; balsam fir - 9,100; hemlock - 3,000; jack pine - 5,300; aspen - 17,300; total - 41,800.

Estimated Volume of Aspen Available 1945 to 1960

While the total volume of aspen in the Lake States is very large, it is not all available for cutting at any one time. It is estimated that only about one-half of the saw timber size material is in stands with sufficient volume per acre to permit economic saw log operations. Only about three-fourths of the total cordwood volume may be considered operable for the same reason. Furthermore, a substantial volume which occurs in otherwise operable stands is not usable at present because of its remote location, high logging cost, low values, etc.

Of the total 1945 volume, substantial quantities are overmature or will be overmature before they can be harvested. Much volume will also be lost by normal rot in immature and mature stands. Hence, 1945 volumes of aspen should be considerably reduced in estimating the amount available to market (see last column in table 3).

On the other hand, growth takes place in all stands and some stands pass from unmerchantable to merchantable status each year. Until 1965, this movement into the merchantable classification will be comparatively slow. Thereafter it will be rapid for a few years when vast areas of restocking material "come of age" (see allowable cut graphs on chart 5, page 14). The length of time aspen can be held is short and it may be advisable to cut some areas early in order to prolong the harvest of these stands and effect more complete utilization.

After 1960 the supply of aspen will probably exceed for a time the maximum which the markets can use. Efforts should be made now to build up the markets, but only to the extent that the supply available will support them. Hence estimates have been made as to the aspen supply available for the period 1945-1960 (see chart 4, page 12).

These estimates made allowance for the previously mentioned facts plus the effects of local market demand and local labor supply. Each district was handled separately. The net loss in the inaccessible district 1, Minnesota, after adding growth, was estimated at 23 percent, leaving 994 million board feet available for cut from 1945 to 1960. The loss in Unit 2, Wisconsin, where close utilization is possible, was small and far overshadowed by growth. There an increase of 125 million feet B.M. (31 percent) is indicated over the 1945 volumes.

Chart 4 indicates predicted cords and board feet of aspen available in each survey district during the period 1945 to 1960. Areas with dots indicate the generalized location of the aspen type.

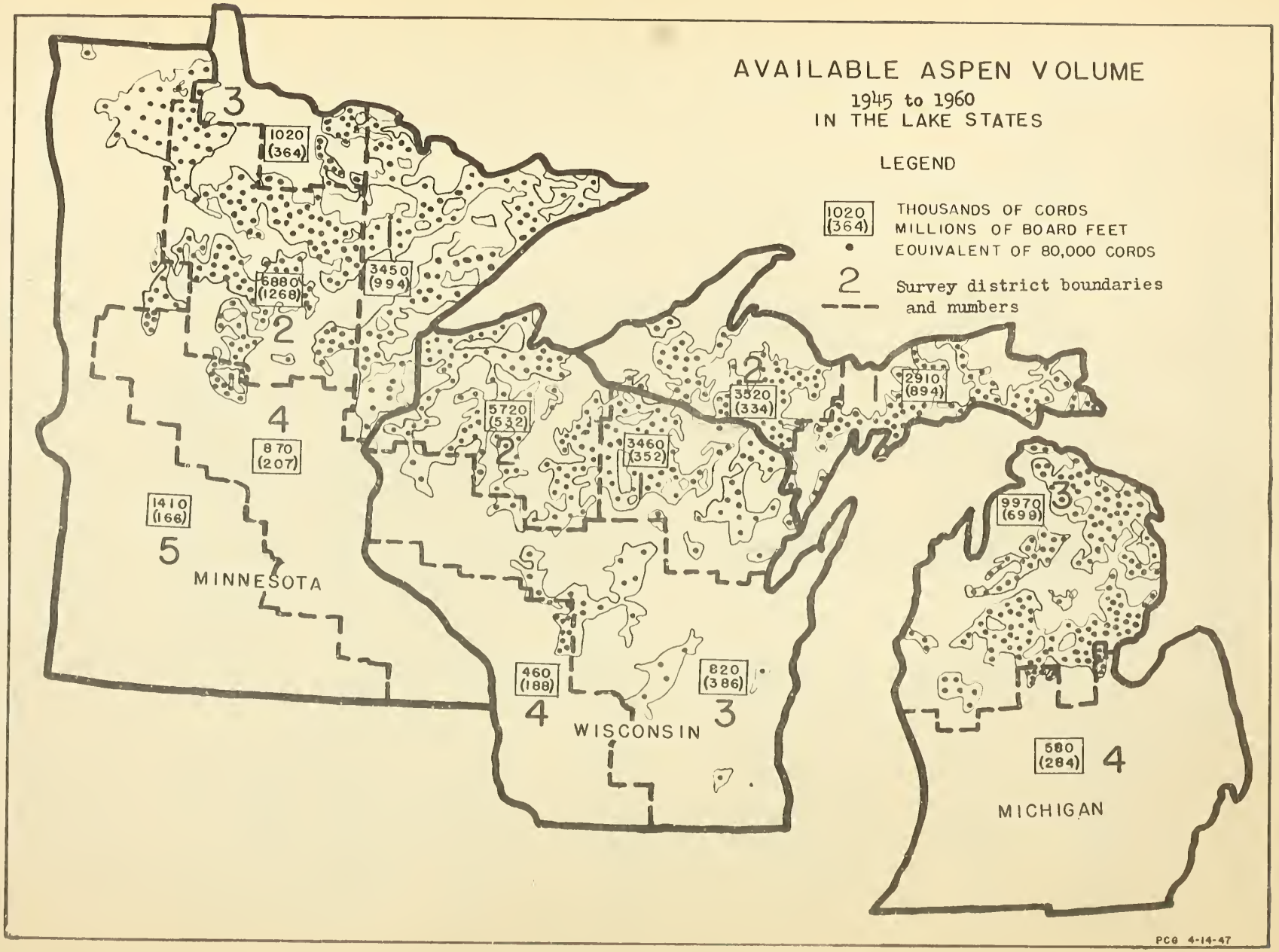
GROWTH, DRAIN, AND ALLOWABLE CUT

Table 7 shows that growth for the 10-year period 1935-44 was considerably greater than drain: in cubic feet four times as great; in board feet $2\frac{1}{2}$ times as great. With such a large area of young aspen, it is expected that the growing stock will increase even further. Aspen is a rapid-growing, short-lived tree; therefore great loss can result from cutting either too early or too late. How much, then, may be cut without depletion of the

Table 7.- Comparison of annual growth and drain for aspen 1935-1944 with annual allowable cut for 1945-1959

State and survey district 1/		Total volume			Saw timber volume		
		Growth 2/	Drain 3/	Allowable cut 4/	Growth	Drain	Allowable cut
		Million cu.ft.			Million bd.ft. (Int. ¼)		
Minnesota	1	55	13	37	54	21	55
	2	56	14	41	59	33	51
	3	21	9	8	22	17	18
	4	7	3	5	6	5	8
	5	4	2	9	4	2	7
Total		143	41	100	145	78	139
Wisconsin	1	23	7	11	38	15	10
	2	34	10	18	61	18	16
	3	12	5	6	22	9	13
	4	2	1	3	6	2	8
Total		71	23	38	127	44	47
Michigan	1	20	3	22	27	8	46
	2	24	5	18	31	10	17
	3	68	9	49	68	15	34
	4	10	3	6	10	5	17
Total		122	20	95	136	38	114
Region Total		336	84	233	408	160	300

1/ See survey districts on map on page 12.
2/ Gross growth, including that put on scattered trees in inaccessible or inoperable stands.
3/ Drain figures include commodity drain (93 percent) and other losses (7 percent).
4/ Allowable cut figures are the average annual volumes which might be harvested for the period 1945 to 1959 inclusive without serious overcutting or undercutting. These are based upon harvest of total 1945 volumes plus growth rather than upon volumes available prior to 1960.


AVAILABLE ASPEN VOLUME
1945 to 1960
IN THE LAKE STATES
LEGEND
1020 (364) THOUSANDS OF CORDS
MILLIONS OF BOARD FEET
• EQUIVALENT OF 80,000 CORDS
2 Survey district boundaries and numbers
1020 (364)
3450 (994)
6880 (1268)
870 (207)
1410 (166)
MINNESOTA
5720 (532)
3460 (352)
3320 (334)
2910 (894)
460 (188)
820 (386)
WISCONSIN
9970 (699)
580 (284)
MICHIGAN
PCG 4-14-47

supply, or excessive waste? It appears that the total cut for the region could be increased almost three times, and the saw timber cut about twice, before 1960, and increased further thereafter.

Chart 5 shows a recommended adjustment of allowable cut, by short periods, for aspen. It indicates the expected rise and decline of the growing stock and recommended annual cut.

These data are taken from a study of potential yields and allowable cuts of all species to meet the timber requirements of the region. Adjustments in cut are based not only on the available supply but also upon an estimated conversion of industry and species use. More intensive management and conversion of 7 million acres of aspen to other forest types are also anticipated. Thus, the future cut of aspen may be estimated about as follows:

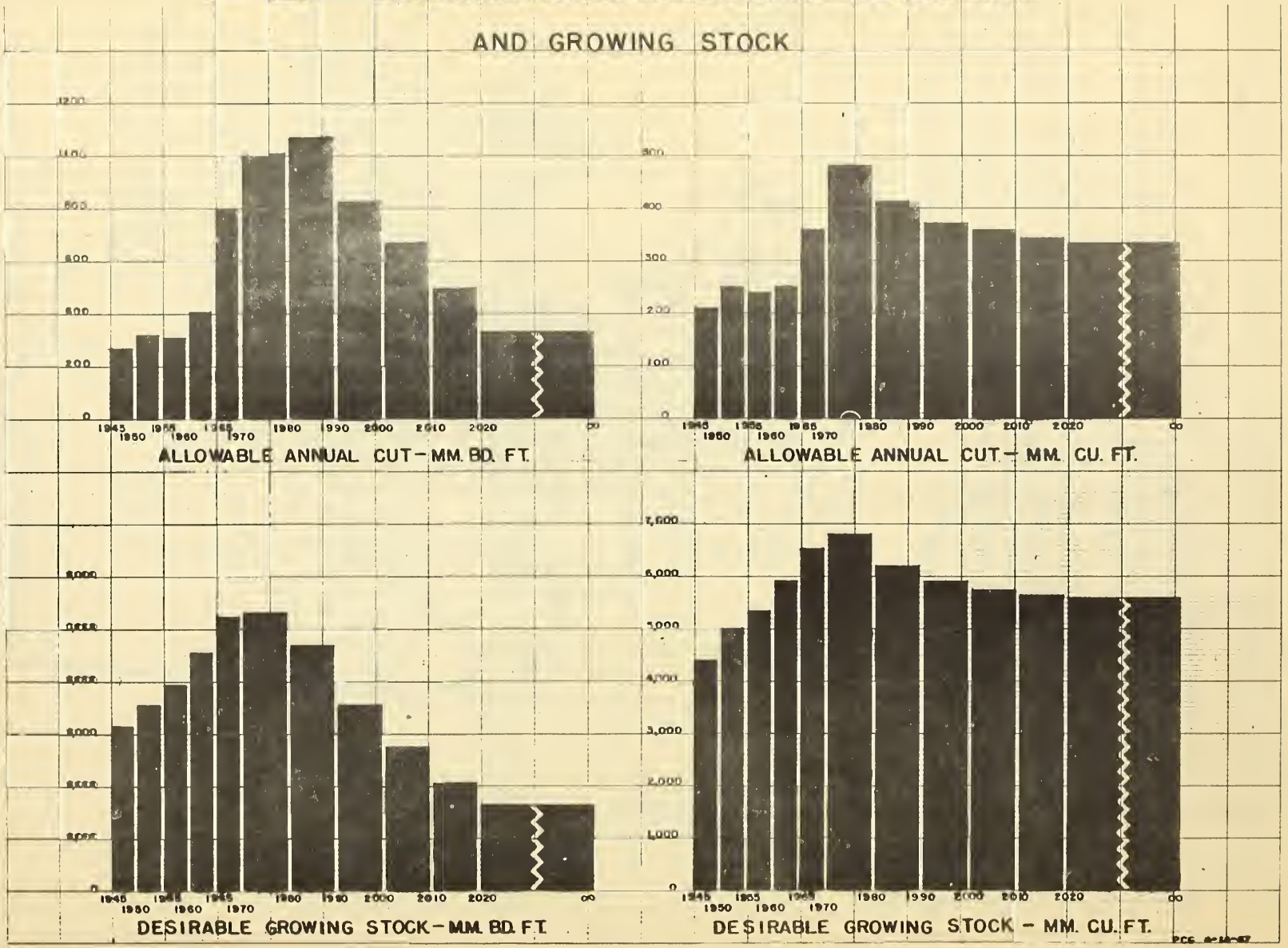
Period		Annual allowable cut	
		Total volume Million cu.ft.	Saw timber volume Million bd.ft.
1945-49		210	270
1970-80	rising gradually to	480	1,010
2020-30	and then declining to	335	330

Since the 1935-44 total drain was only 84 million cubic feet annually (160 million board feet) it is clear that the use of aspen in the Lake States can be greatly increased immediately and that a much heavier cut can be maintained in the future than in the past.

If information as to specific location of aspen stands and the available volumes is desired, the Conservation Department of the state concerned or the Regional Forester of the U. S. Forest Service, Milwaukee, Wisconsin, should be contacted. As the new Forest Survey progresses, it is planned to release statistical reports by counties or other small units, through the Conservation Departments or counties.

CHART 5

RECOMMENDED ADJUSTMENT IN ALLOWABLE ANNUAL CUT AND GROWING STOCK



LITERATURE

"Forest Areas and Timber Volumes in the Lake States," Economic Note No. 10, Lake States Forest Experiment Station, 1938.

"Revised Forest Statistics for the Lake States, 1945," Station Paper No. 1, Lake States Forest Experiment Station, 1946.

"Michigan Forests A Great Resource," by J. A. Donery, American Forests, May, 1945.

"Minnesota's Forest Wealth," Forest Industries Information Committee of Minnesota, 1946.

"Wood Utilization Problems and Possibilities in Michigan," Michigan Planning Commission, 1946.